Children's screen use: its influence on sleep and behaviour.

1. Abstract

With the rapid development and increasing accessibility of technology in recent years, the effect of screen time on young children is a growing concern due to links to sleep disturbances and behavioural issues. This study considers information from a 2024 dataset collected by Emma Axelsson, measuring screen time, sleep duration, and behavioural problems in 113 children aged 3-6, using the The Child Behavior Checklist (CBCL) scale. We argue that screen time was associated with reduced sleep duration and higher behavioural problem scores in participants. The findings highlight the need for more research into the effects of screen use on child development to allow for improved parenting and public health guidance.

2. Introduction

The growing prevalence of screen use in young children and adolescents has provoked concerns amongst carers and health professionals - with raising questions about development and child mental health. The general consensus seems to be that excessive screen time, particularly before bed, may contribute to sleep disturbances, and is also linked to problems with behaviour and developmental disruptions (Children's Hospital of Orange County, 2024). However, because these studies are so subjective, findings can be inconsistent - therefore there is a clear need for further analysis to assess the significance of these issues amongst children.

This study examines the relationship between screen time, sleep duration, and behavioural problems (measured by the Child Behavior Checklist (CBCL)) in young children (ages 3 to 6), using Emma Axelsson's dataset. The key findings suggest that increased screen use results in reduced sleep duration and higher problematic behavioural scores, especially when screens are allowed immediately before bedtime. The study shows that a greater amount of screen time can lead to up to half an hour less total sleep on average (10.3 compared to 10.8), and the number of behavioural problems tends to vary less among participants with greater screen time, and at higher totals.

When identifying gaps in research tha our project can address we found a study by Duch et al. (2013) which has found that excessive use of screen time in young children can be linked with negative health outcomes. The paper mentioned that most studies focus on children of 7 years or older, but not a lot of data has been collected so far on infants and toddlers (ibid). Hence why we decided to focus on a dataset providing information on screen use, behavioural and sleep patterns of children younger than 6 years.

The report begins by outlining the dataset and the key variables used in the analysis. We then introduce our chosen statistical models and present the results, followed by a discussion of their implications, as well as potential limitations in the dataset and our

findings. Finally, we discuss potential directions in which to take future research and recommendations for child health guidelines.

3. Data

Emma Axelsson's dataset was deemed suitable for our study as, while there may be other datasets covering similar information, this one was collected within the last 2 years, ensuring it reflects current media consumption. It also features a specific breakdown of screen use (both duration and type of entertainment being consumed) which allows for an especially detailed outlook of this topic. Furthermore, the inclusion of the CBCL score as a measure of behaviour is advantageous to our analysis as, while observing child behaviour is often subjective, the provision of quantifiable responses to the questionnaire makes the collected data both standardised and measurable.

The chosen variables (described in Fig. 1 as they appear in our statistical tests) were put into data visualisation models using python.

1. `participant`: number of participant (out of 77 valid)
2. `child_age_yrs`: child's age in years (between roughly 3 and 6 years old)
3. `avg_daily_sleep_hrs`: average daily sleep in hours across the week
4. `avg_daily_film_tv_hrs`: average daily screen time consisting of films and tv across the week
5. `avg_daily_youtube_hrs`: average daily screen time consisting of youtube across the week
6. `avg_daily_screen_time_hrs`: average daily screen time in hours across the week
7. `days_in_week_before_bed`: number of days a screen is used within half an hour before they go to sleep in the evening across the week (out of 7)
8. `CBCL_total_problems`: score using CBCL (out of 226)

Fig.1

Before this testing was carried out, the data was cleaned and specific variables were chosen from the dataset. First, we realised there were duplicates of every participant's entry in the dataset - one version as raw data and one already coded which happened to be empty. The total 113 participants were narrowed down to 77 due to missing data, in order to maintain consistency across our refined dataset. Variable names were inconsistent and difficult to incorporate into the models, so some were renamed or reformatted for ease of the analysis. Out of a total of 130 variables (not including one used to identify participants), 7 were selected that were expected to best relate to the research - caregiver perceptions was not our group's main focus, and due to efficiency we did not want to include every single specific variable available, meaning we used some useful variables that measure the averages across the week instead. Furthermore, the types of media consumption considered were kept to a smaller number (films and TV, YouTube) to allow for more specificity. Child

age was also used as a control variable to account for factors impacting sleep duration outside of screen exposure, such as developmental differences between age groups.

4. Model

Firstly, we started with a minimal model of average sleep time against the amount of screen time, both reported as daily averages in hours across the week of the study. “Avg_daily_sleep_hrs ~ avg_daily_screen_time_hrs”.

Then we visualised a third variable - “CBCL_total_problems” which corresponds to each child’s total score on the CBCL questionnaire - in a bubble plot (Fig.2). In doing that we tried to see if the minimal model followed our hypothesis of screen use affecting children’s behavioural issues.

The second model we carried out in our analysis includes the variable of the child’s age (in years) as a control variable “avg_daily_sleep_hrs ~ avg_daily_screen_time_hrs + child_age_yrs”.

Then we created a maximal model for sleep and screen time, which included the amount of screen time in film & TV and YouTube categories, both reported in hours, as well as the variable for days in a week where a screen was used before bed. “avg_daily_sleep_hrs ~ avg_daily_screen_time_hrs + child_age_yrs”.

To complement the previous model we ran another maximal model, this time using the CBCL total problems variable as the outcome. It featured the same variables as well as average total screen time reported in hours. This one gives the strongest prediction (R-squared = 0.113) “CBCL_total_problems ~ avg_daily_screen_time_hrs + avg_daily_film_tv_hrs + avg_daily_youtube_hrs + days_in_week_screen_before_bed”.

Then we could start creating a pairplot (Fig.3) to see how each selected variable in the dataset relates to each other in a scatter plot format.

Then we created one more minimal model where the amount of sleep (again in hours) is used as a predictor for days in the week where a screen is used before bed (Fig. 4). This model indicated only a very weak relationship (R-squared = 0.001). “days_in_week_screen_before_bed ~ avg_daily_sleep_hrs”.

Lastly, to see if the type of screen time plays a role in sleep, a proportional stacked bar chart (Fig. 5) was created. In said bar the types of screen time were grouped by children who slept for below the average amount across the group, and by those who slept for more. The sum of these hours of screen time were then used to calculate the proportion of each type of screen time (film &TV against YouTube) in each of the two groups of children (sleeping below or above the average amount). This was plotted on a stacked bar chart. “avg_daily_sleep_hrs, avg_daily_film_tv_hrs & avg_daily_youtube_hrs”.

5. Results

Minimal models show low explanatory power, with R-squared values around 1% and a maximum of only 11%. Those values indicate that the chosen variables do not significantly explain the variation in results.

To improve the model's effectiveness, dozens of additional variables would need to be included, suggesting that no single variable is substantial enough on its own. This limitation shows our findings ineffective, regardless of the variable chosen.

Additionally, constraints such as the study's small sample size and the limited pool of participants make the effect difficult to measure. Factors like young children's sleep being influenced by numerous unaccounted variables and the uncertainty surrounding the timeframe of data collection further weaken the study's reliability. If the data were only gathered over a short period of time (such as a week or a month) it would fail to capture the long-term trends necessary for meaningful conclusions. The low statistical significance, compounded by a small effect size and limited sample size, makes the observed effects less noticeable and less likely to be published.

Given these limitations, the findings may be deemed inconclusive, suggesting that the widely accepted notion of screen time negatively impacting sleep and behaviour in children cannot be confirmed using this dataset alone.

The first bubble plot of screen time against sleep duration (Fig. 2) showed a very weak negative correlation. Most data points were concentrated around 0-4 hours of screen use, with sleep durations of 10-11.5 hours, and while the line of best fit indicated a slight downward trend, the relationship was not strong.

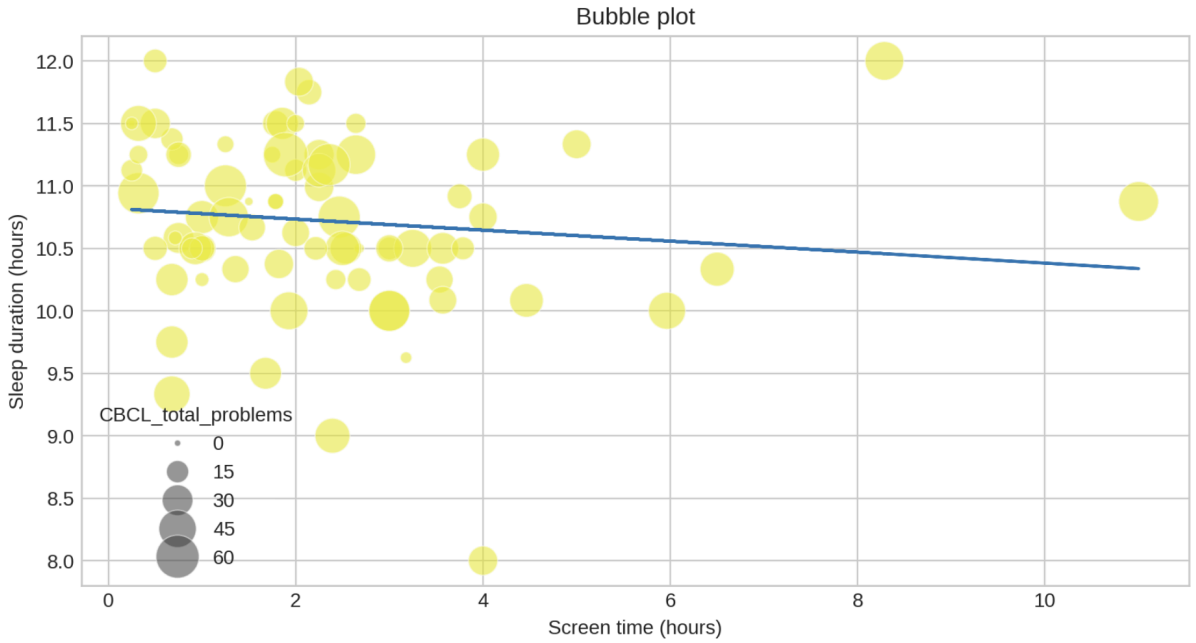

Fig. 2

A second graph examining the number of days per week that screens were used before bed compared to sleep duration (Fig. 3) also showed a weak negative correlation.

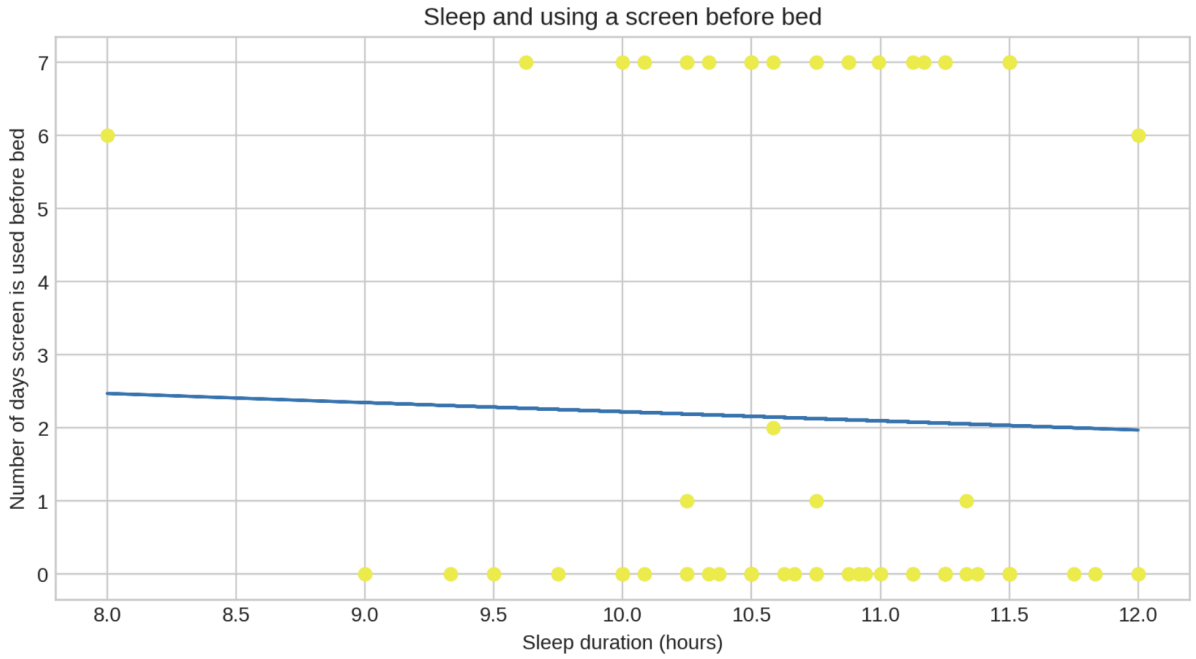

Fig. 3

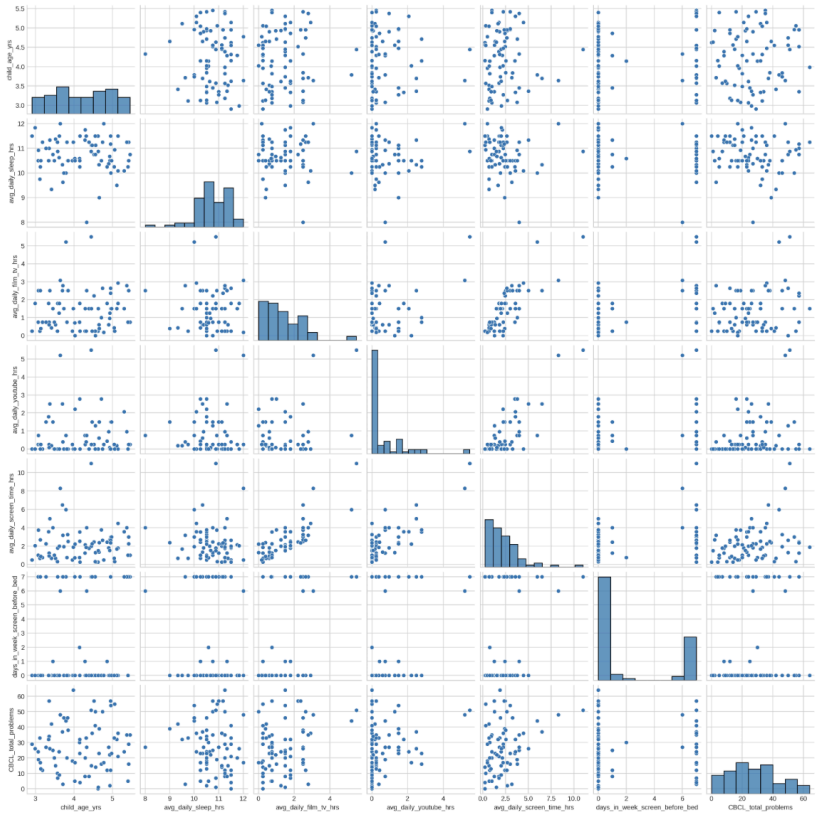

Fig.4

After our first two analyses revealed no significant correlations, we generated multiple visualisations (Fig. 4) to examine the relationships between all selected variables. The variables included were: children's age (years), average sleep duration (hours), average daily screen time (hours), average daily YouTube use (hours), average daily movies and TV use (hours), times when screen was used before bedtime (days), and total behavioral problems (CBCL score). The scatterplots show no clear linear trends between most of the variables. Most of the plots seem to display a random spread of points, also suggesting weak or no correlation between the chosen variables.

The histograms display the distribution of each variable, with some being highly skewed. The average daily screen time, YouTube, movies and TV use appear to be skewed to the right, meaning younger children tend to use the screen more and spend more time watching YouTube or TV. The children's age and the total CBCL problem score show a uniform distribution, highlighting the more prominent use of screens in younger children. The average sleep histogram shows older children to be sleeping longer, while both the youngest and oldest children tend to use screens more often before bedtime, with the data being slightly higher skewed to the right (younger children).

The CBCL total problems score (a measure of behavioural issues) appears to have some spread in relation to screen time variables, but no strong correlation. The relationship between CBCL scores and sleep time also remains unclear.

Lastly, most data points for screen use before bed are concentrated at low values, meaning younger children are more likely to use screens before bedtime.

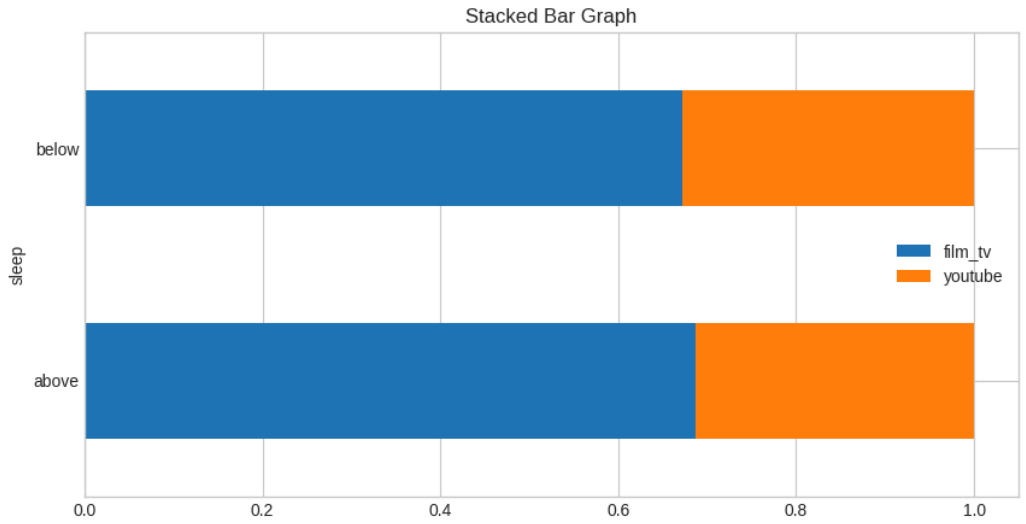

Fig.5

To further explore the relationship between screen use and sleep, we created a stacked bar chart (Fig. 5) comparing different types of screen content consumption among children with above- and below-average sleep duration. The results revealed two nearly identical bars, indicating that both groups of children have very similar screen time consumption patterns.

6. Discussion

6.1 Overview

This study aimed to explore the relationship between screen time, sleep duration, and behavioural problems in children aged 3-6. Using data from Emma Axelsson's 2024 dataset we employed statistical models to test whether increased screen time led to reduced sleep and higher behavioural problem scores.

6.2 Key findings

Analysing both the screen time and amount of days screens were used by children before bed against their sleep duration suggests that while higher screen time may be associated with less sleep, the correlation is too weak to be able to infer any strong causality. Despite common assumptions that screen use before bed significantly disrupts sleep, our findings indicate that the impact may be minimal.

The results of comparing screen use type between children who slept below and above the average amount showed no significant difference - the observed children who sleep below- and above-average display nearly identical screen use patterns. If certain types of screen time had a significant impact on sleep we would expect at least a noticeable difference in proportions between the two groups, so the similarity between the two bars indicates that the content type may not be a decisive or very influential factor in sleep duration, at least within this dataset.

When analysing CBCL total problem scores against screen time, we found no strong correlation which implies that screen time alone does not appear to be a major predictor of behavioural difficulties in young children. However, since behavioural issues are complex and influenced by multiple environmental and genetic factors, a more detailed study incorporating more variables would be necessary to draw stronger conclusions.

The visualisations generated in our analysis also showed no clear negative correlation between average daily sleep and screen time variables (YouTube, TV, or total screen time). This suggests that increased screen time does not strongly predict reduced sleep duration in this dataset. The data showed no strong relationship between sleep or screen use duration and behavioural problems suggesting that behavioural problems are not significantly associated with sleep length or screen use in this dataset. We also found no strong trends linking bedtime screen use with sleep duration.

6.3 Limitations

While this study provides insights into the relationship between screen time, sleep and behaviour in children, there are a variety of limitations to consider:

- Small sample size: After data cleaning, only 77 participants remained which limits statistical power and broad applicability, thus decreasing the population validity of the findings

- Self reported data: Both screen time and sleep duration were based on parental reports, which may be subject to bias or inaccuracy
- Lack of contextual factors: The dataset didn't include information on other confounding variables and context such as the style of engagement (passive vs interactive), physical activity and diet just to name a few

The study conducted by Domingues-Montanari (2017) has reported that "television viewing negatively affects the cognitive and socioemotional development of children, and excessive screen time is associated with poorer mental health during adolescence". This finding could indicate that the negative effect of screen time might not be visible in young children simply due to them not being exposed to screens for long enough to display the negative effects. Domingues-Montanari (2017) further argues that the presence of screens in children's bedrooms (which could loosely relate to our "use before bedtime" variable) impacts not sleep duration but its efficiency that was not measured in the data our report analysed.

Duch et al. (2013) have come across similar limitations as we did in our report as well. In their report 29 studies were identified and they investigated 33 potential correlates influencing sleep patterns and behaviour changes in children using screen time. Most of their findings were also concluded to be unclear (Duch, 2013) with an indication of carrying out more studies necessary "to explore a number of environmental, socio-cultural and behavioral correlates" influencing the way children interact with screens and the effect on their behaviour.

6.4 Future Research

Future research should aim to use larger samples, objective sleep tracking (e.g. wearable devices) and more detailed assessments of screen use, including factors like not only the type of screen use but the type of content consumed. Additionally, longitudinal studies could help determine whether screen time has cumulative long term effects on child development.

7. Conclusion

In summary, our analysis found only weak evidence supporting the idea that screen time negatively affects sleep duration in young children. The negative correlation between screen use and sleep was present in the dataset we used but by no means strong, and screen use before bedtime only had minimal effects. We found no clear evidence that increased screen time negatively impacts sleep in this dataset. Additionally, the stacked bar graph suggested that content type did not play a major role in sleep differences, and lastly no significant relationship was found between screen time and behavioural problems.

These findings suggest that while excessive screen use should still be monitored and regulated, simple restrictions on screen duration may not be the most effective strategy for improving a childs' sleep and behavioural issues. This study was limited by sample size or missing confounding factors. More attention should be given to factors such as screen content, engagement style, bedtime routines and overall lifestyle habits. With our analysis

showing no strong correlations between screen use and sleep duration, this study requires further investigation with a larger dataset and additional variables.

Reference List:

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Duch, H., Fisher, E.M., Ensari, I., Harrington, A. (2013). Screen time use in children under 3 years old: a systematic review of correlates. *International Journal of Behavioral Nutrition and Physical Activity*, 10(102). Available at: http://www.ijbnpa.org/content/10/1/102

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